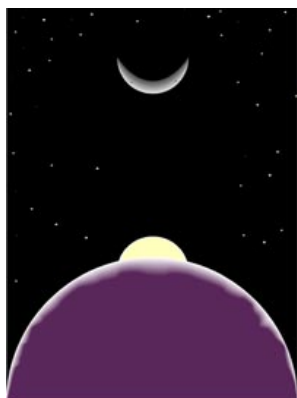


Cosmic Chemistry: An Elemental Question

Development of a Model: Analyzing Extraterrestrial Elemental Abundances

STUDENT ACTIVITY



Genesis mission scientists are working to make sense of diverse data from a number of bodies in our solar system. By analyzing this data, they can offer possible explanations as to the origin of our solar system with a greater degree of confidence.

This data constitutes a portion of what is presently known about the isotopic abundances of oxygen in various bodies in our solar system. Isotopic abundance is considered a key to the quest for answers and creation of further theories.

The central question becomes one of how we can best model this data to determine what is critical at this point of our investigation. Along with the mission scientists, use the data as an attempt to shed light on a great mystery.

Table 2: Extraterrestrial Isotopic Abundance Data Set

| Oxygen Isotopes | Asteroidal Material | Moon | Mars | Meteorite B | Meteorite A |
|-----------------|---------------------|----------|----------|-------------|-------------|
| ^{16}O | 99.758 | 99.76077 | 99.76077 | 99.76505 | 99.76854 |
| ^{17}O | 0.0385 | 0.03821 | 0.03821 | 0.03741 | 0.03691 |
| ^{18}O | 0.2035 | 0.20102 | 0.20102 | 0.19754 | 0.19455 |

Show your calculations and attach graphs.

Questions:

- Record the questions, reasoning, decisions, and outcomes of each type of data calculation and representation (graph) your group employed. You may describe these processes in the format of the Successful Problem-Solving Process Log, an adapted version of this format that your group has agreed upon, or in any other clearly understandable fashion.
- Use of prior knowledge, upon which explanations are built and questions are formulated, is an important part of scientific inquiry. Think back on the various activities you engaged in throughout this module. What things did you learn in each activity that were helpful in guiding your group's modeling and decision-making progress in this final activity? Please describe this information and connection thoroughly.
- Before you began this module, you and your teammates doubtless had certain preconceptions about elements, our Earth, and the solar system.
 - Describe which, if any, of these prior concepts have changed as a result of your work during this module.
 - Discuss *why* you think these concepts changed.
 - What is it that you did to reduce any negative effects these prior concepts might have had on your learning?

4. Recall the meaning of the term *anomaly* and the types of *anomalous data* with which scientists are often presented.
 - a) What types of anomalous data did your team encounter in its modeling that could affect future work?
 - b) How can you deal with anomalous data, and rationalize or make sense of it in light of the helpful information your model reveals?
5.
 - a) What types of mathematical calculations are necessary to arrive at your model?
 - b) What difficulty did these calculations present to your group, if any?
 - c) How well did your data lend itself to interpolation and extrapolation?
6.
 - a) What explanation did your group hope to develop from the data and your final mathematical model?
 - b) How confident can you be of these explanations, or even of the accuracy of the data itself?
 - c) What are the possible sources of error and how extensive are these?
7.
 - a) What additional data or information do you feel is needed to add usefulness or clarity to your model?
 - b) Are there better ways to go about determining what is needed in order to propose more logical explanations, gather more useful information, or organize and/or present the information in a more efficient manner?
 - c) How could this help to reduce or minimize sources of error?
8. In presenting your findings and reflective problem-solving processes to the other student teams in your class, your group doubtless faced a number of difficult tasks.
 - a) What difficulties do you feel scientists face in explaining their reasoning and reflective processes to people who may know nothing about what they are undertaking? Use examples from your group's experiences in this activity.
 - b) How can you account for, refute, or support explanations that are different from your own?